



UNIVERSITY OF TARTU
Tartu Observatory

Measuring Distances to yellow super- and hypergiants in the Milky Way

Anni Kasikov

In collaboration with:

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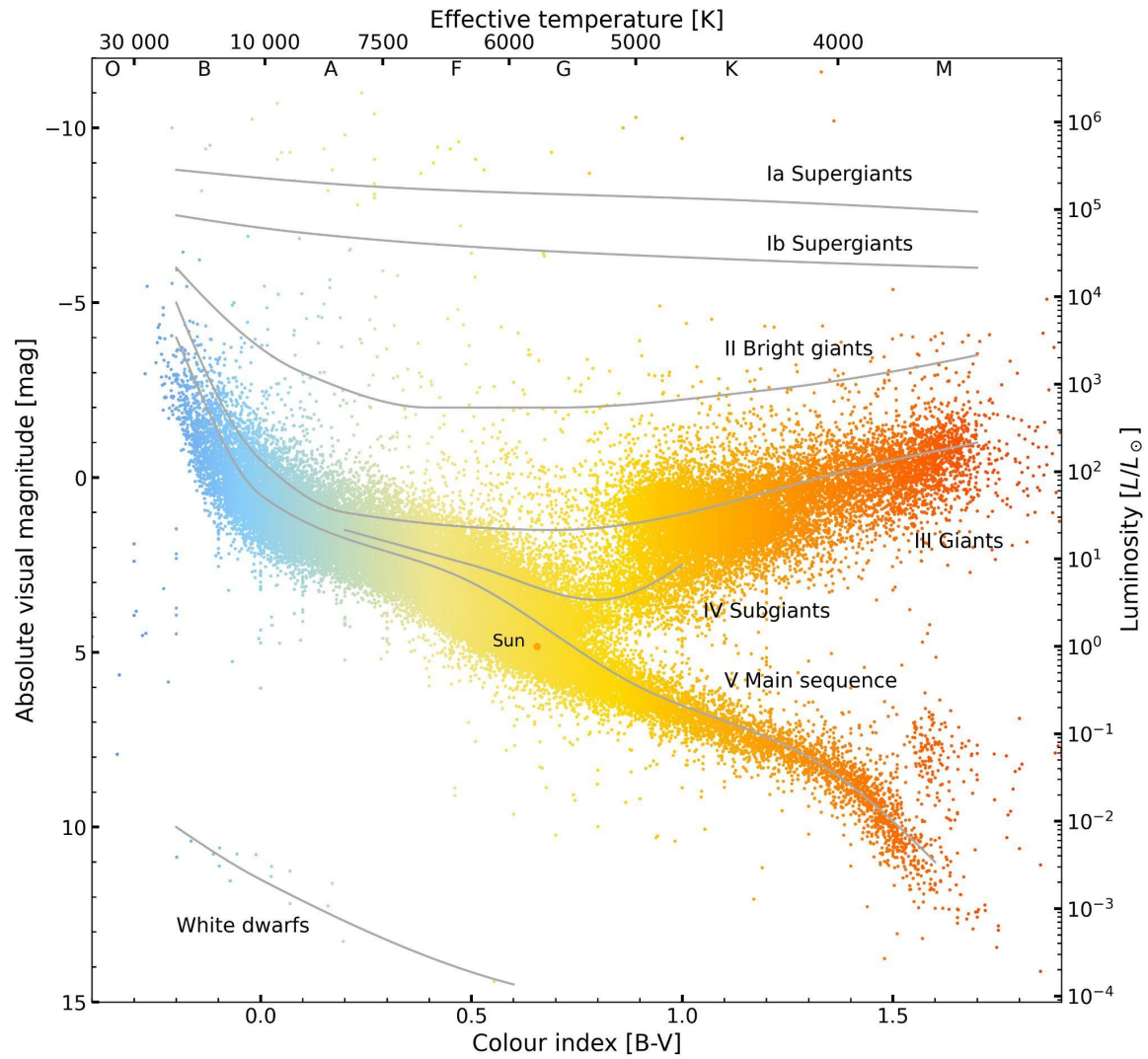
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European Union

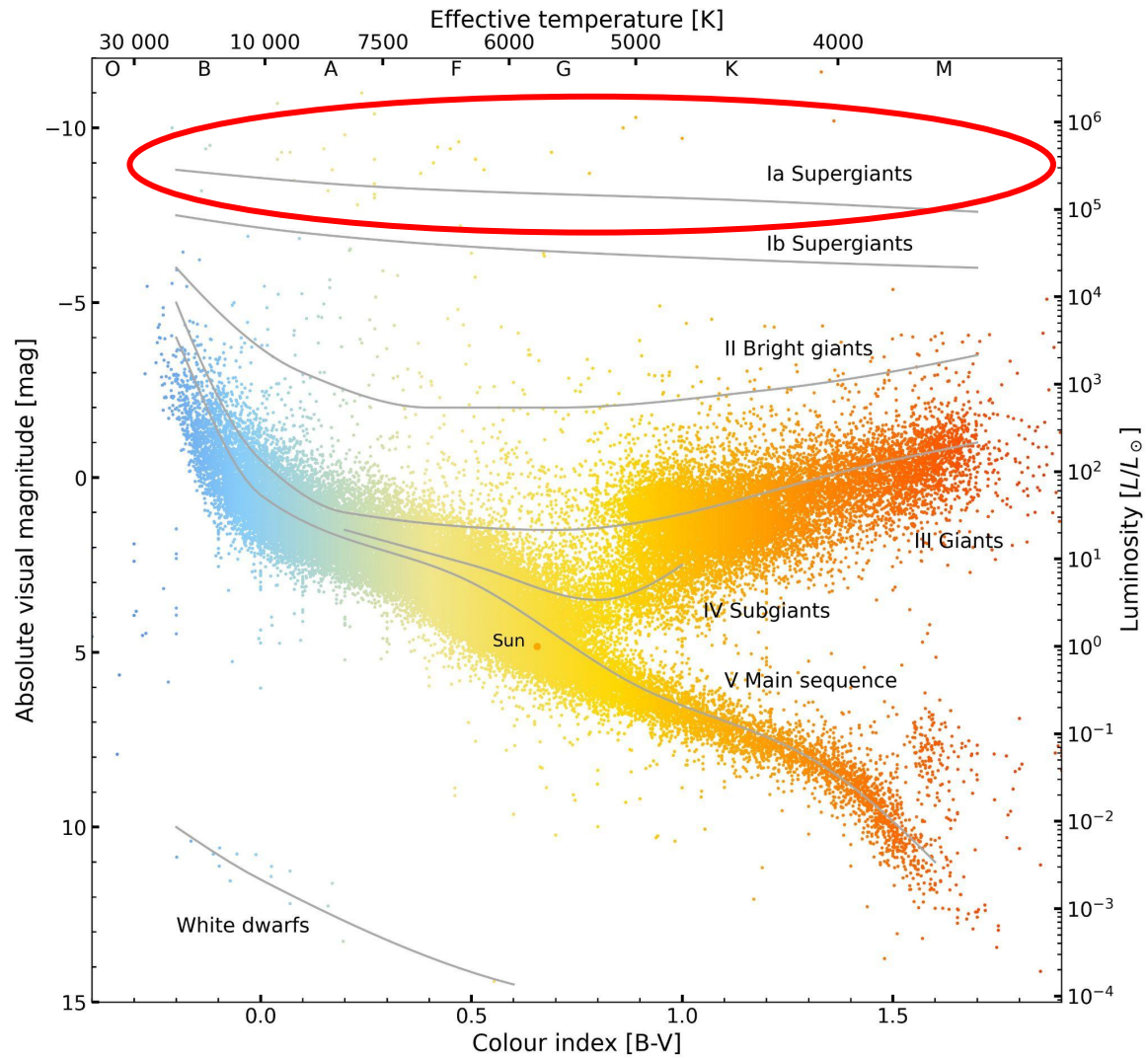


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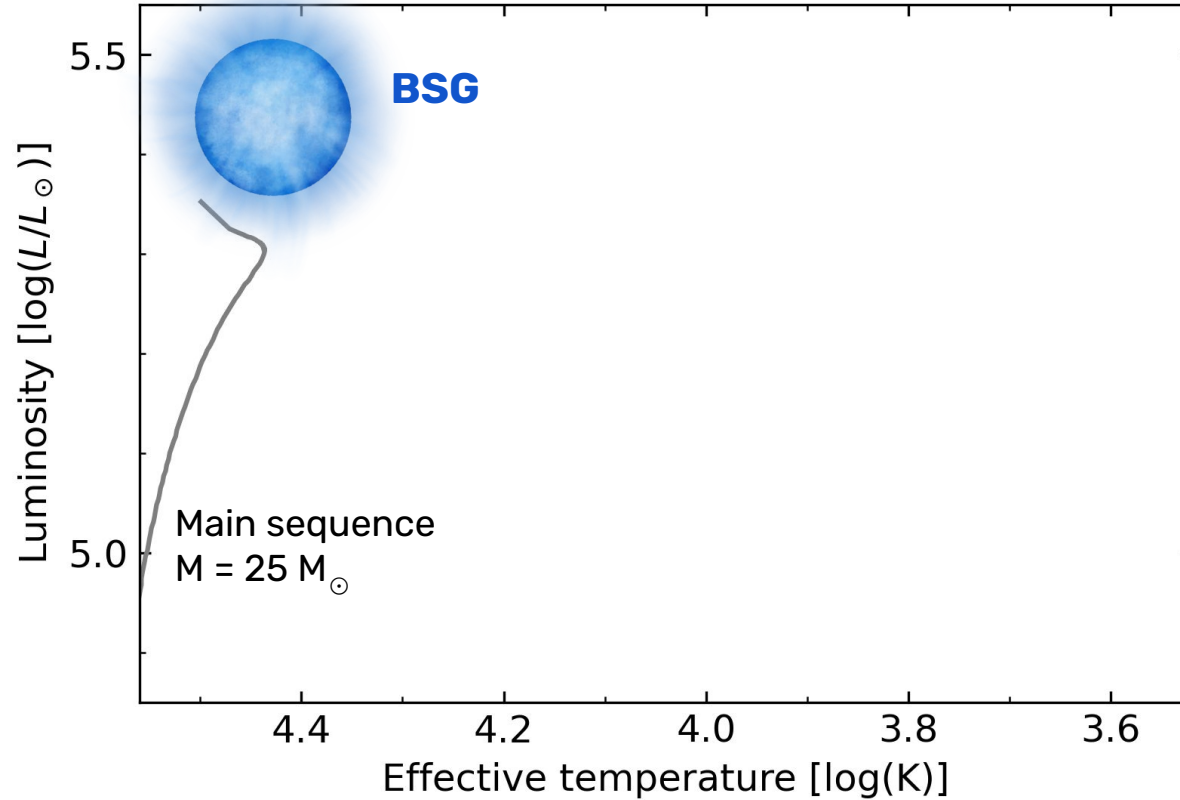
Turku,
28th May 2026





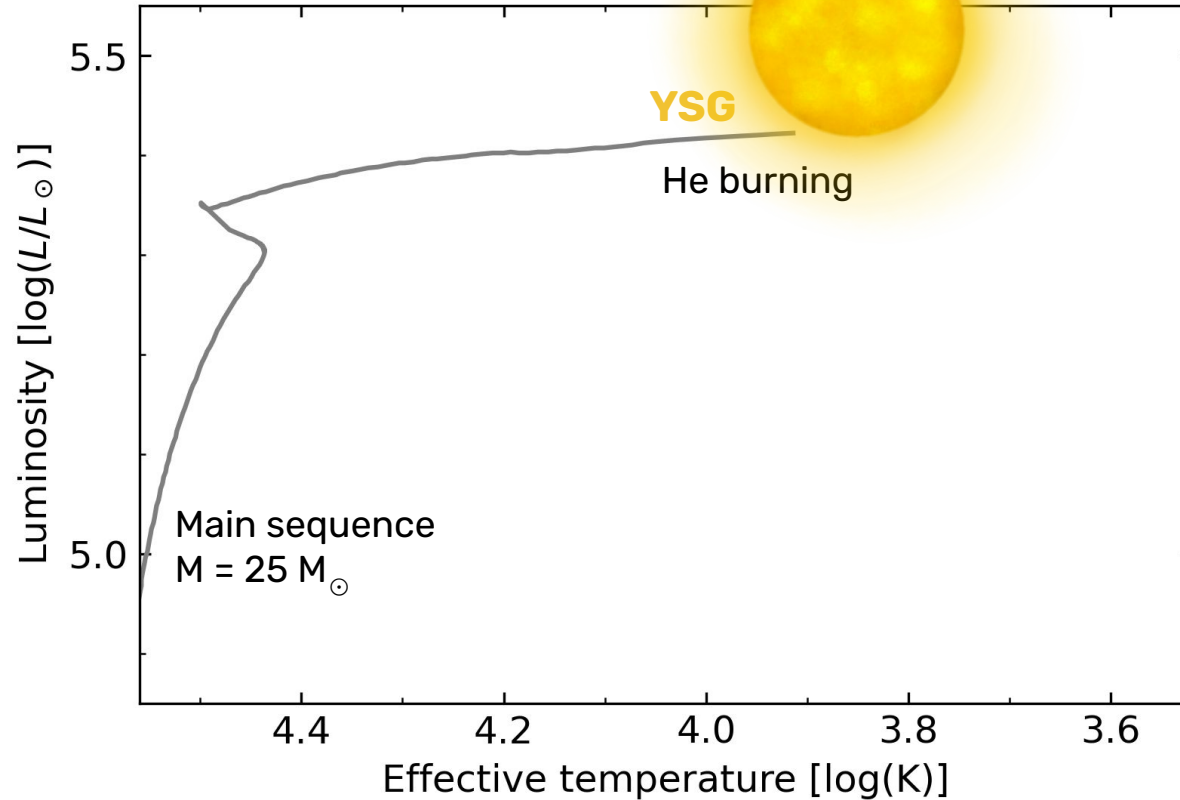


Evolution of massive stars



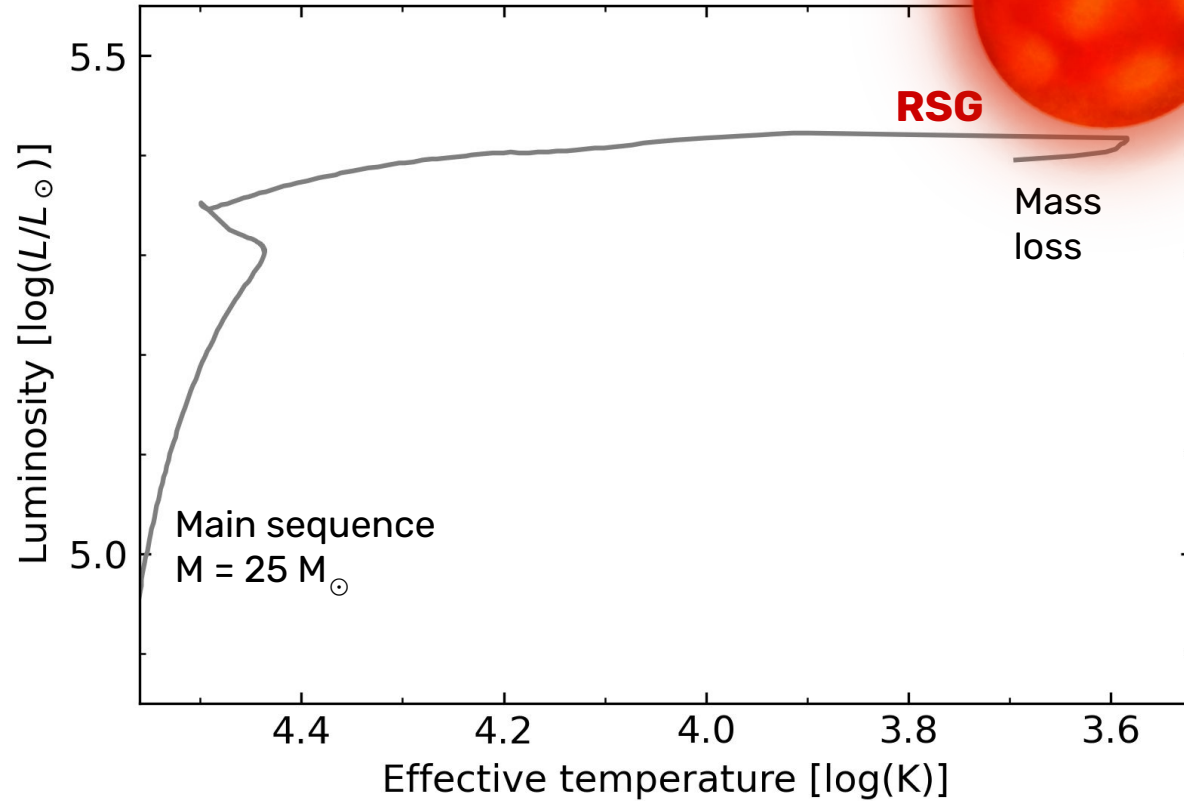
Track: Ekström
et al. 2012

Evolution of massive stars



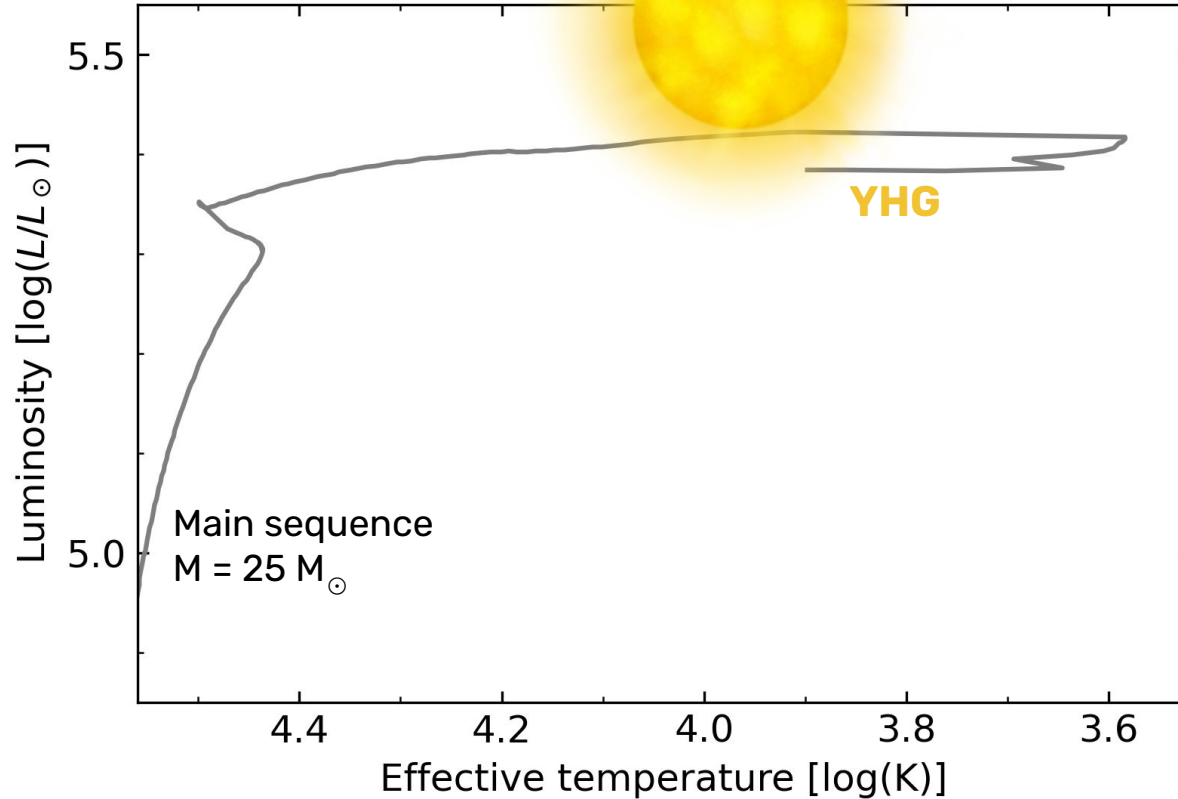
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et al. 2012

Evolution of massive stars



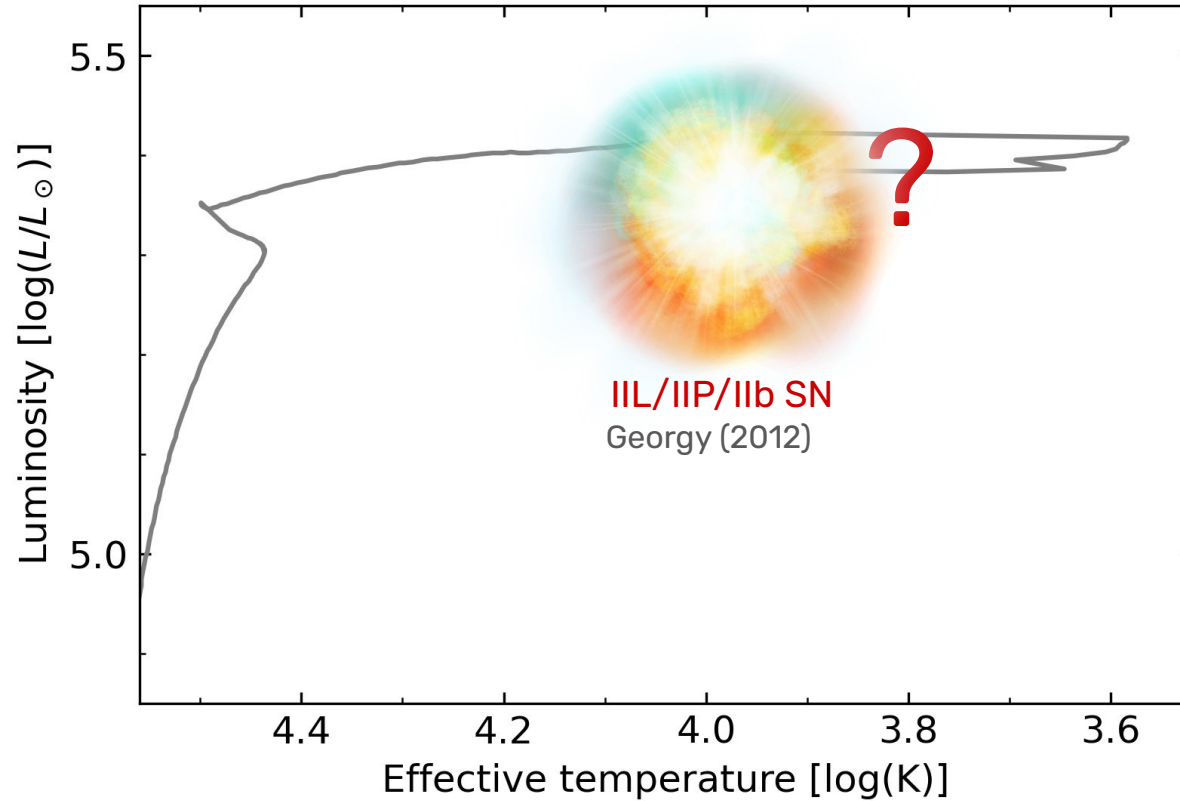
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Evolution of massive stars



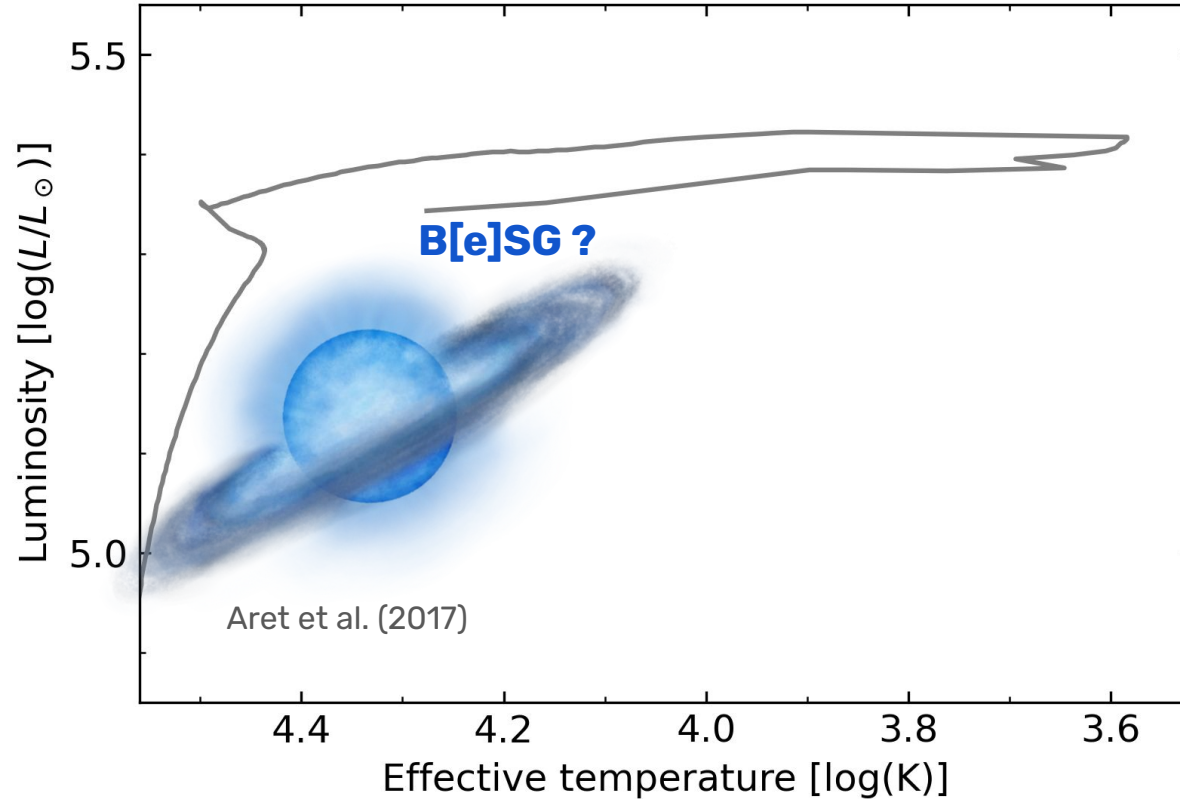
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Evolution of massive stars



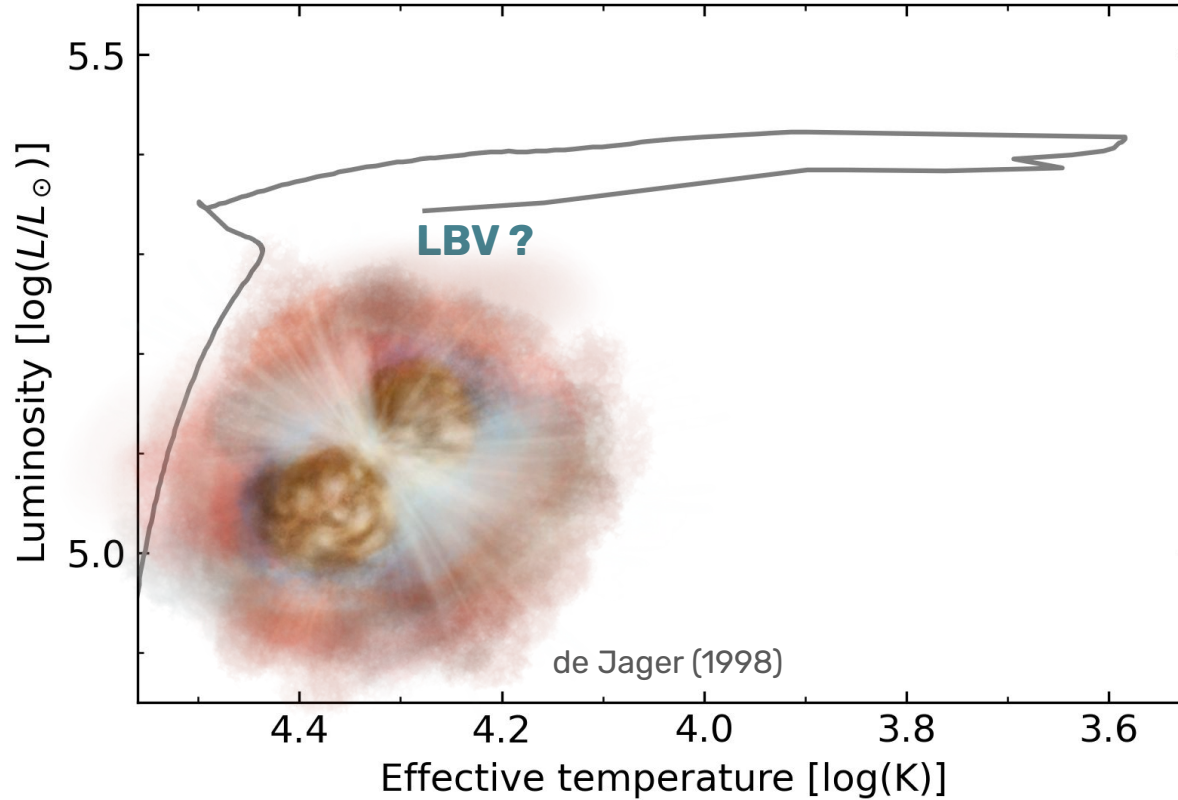
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Evolution of massive stars



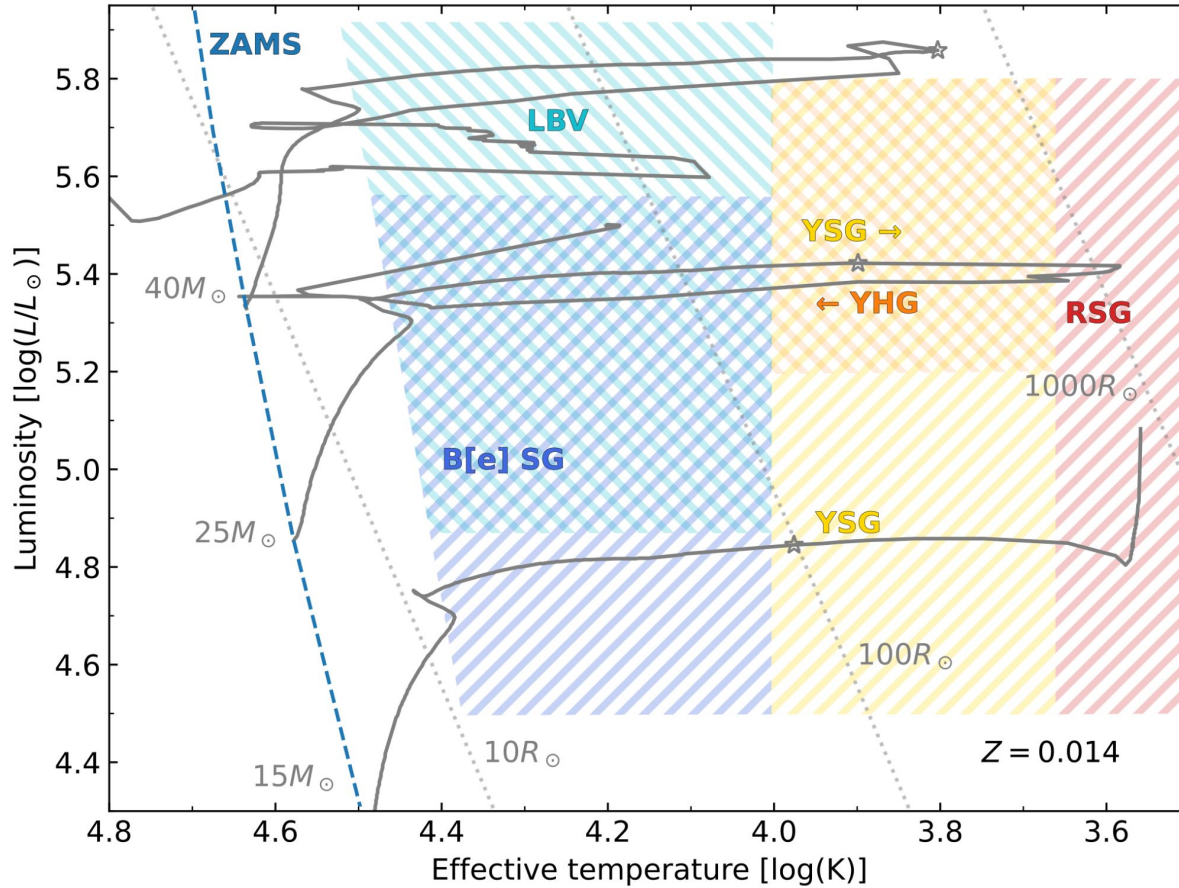
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Evolution of massive stars



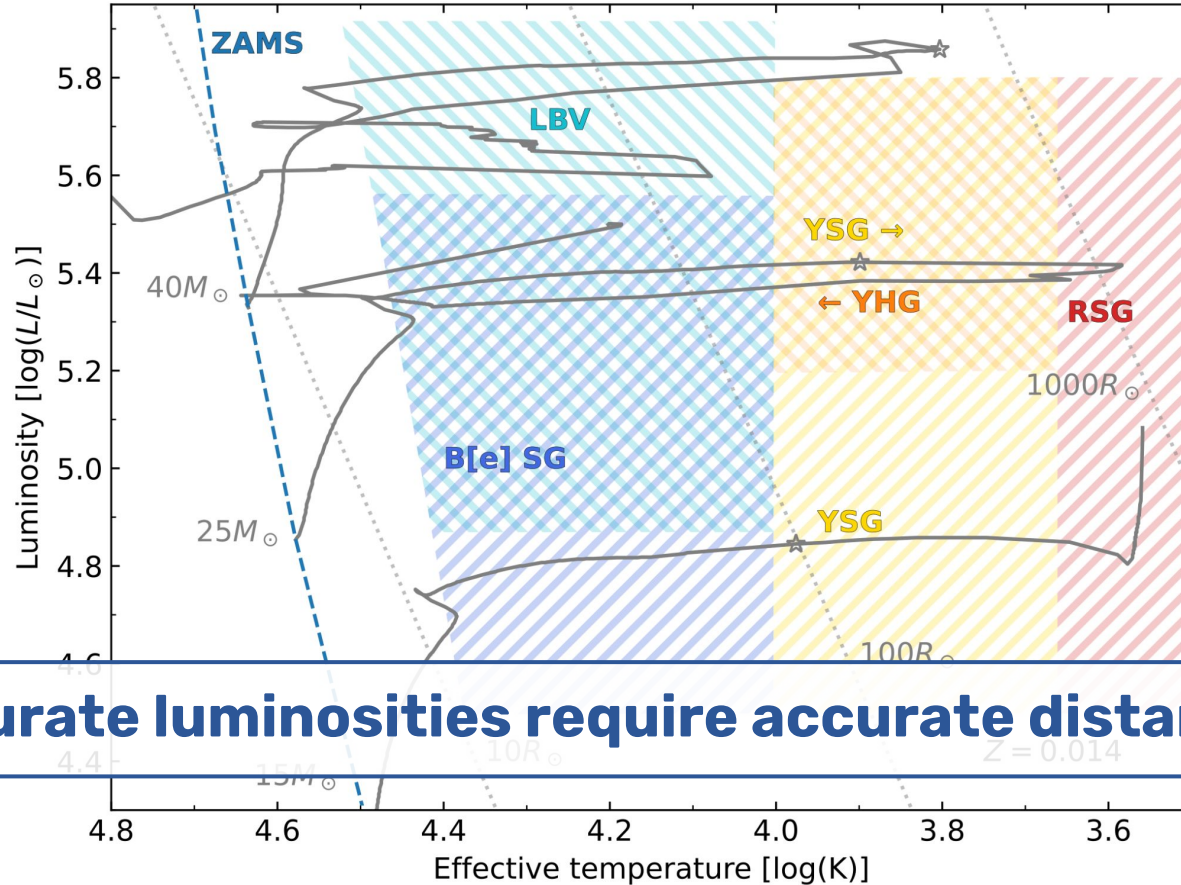
Track: Ekström
et al. 2012

Evolution of massive stars

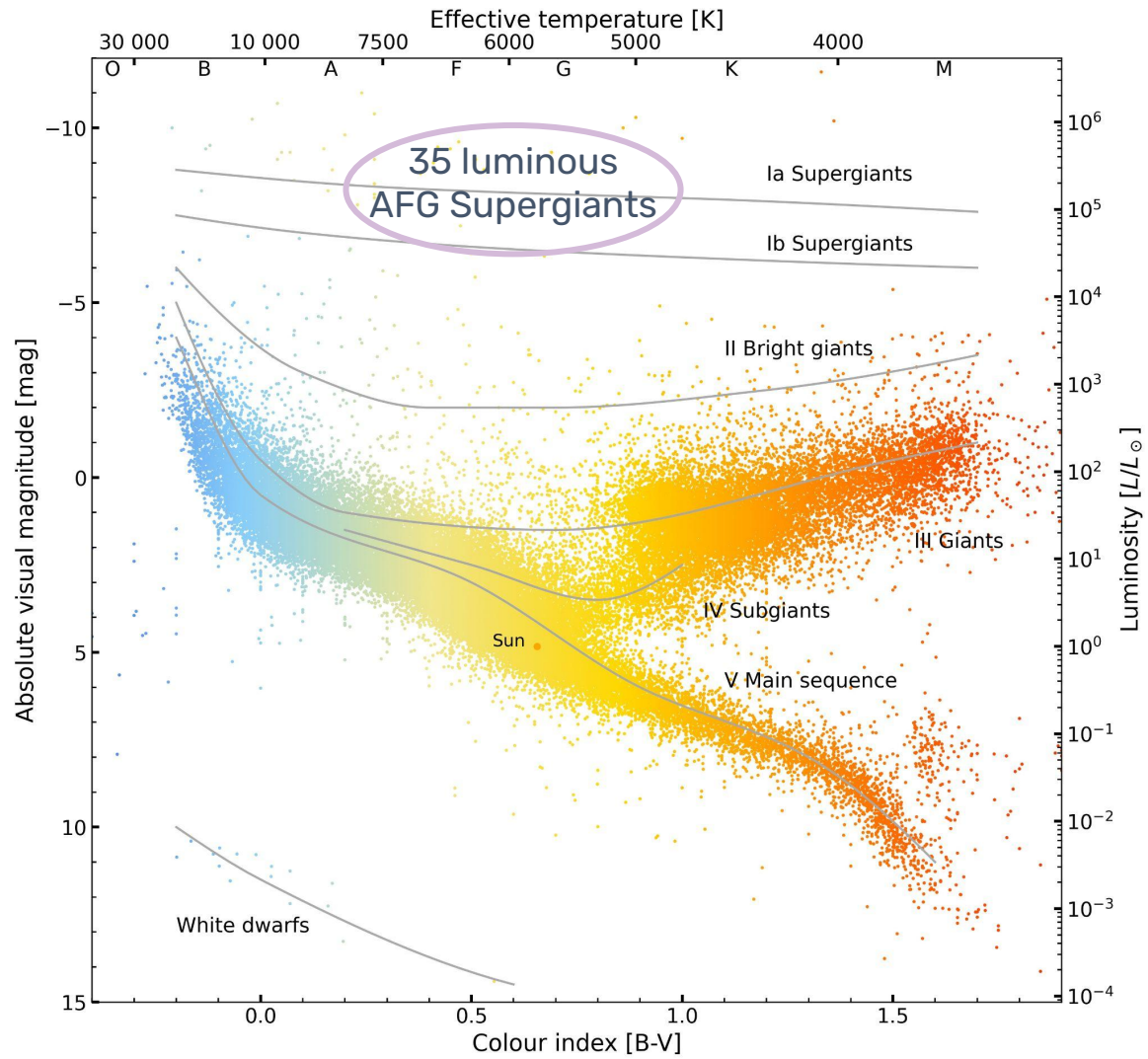


Track: Ekström
et al. 2012

Evolution of massive stars



Accurate luminosities require accurate distances!



Distances to evolved massive stars

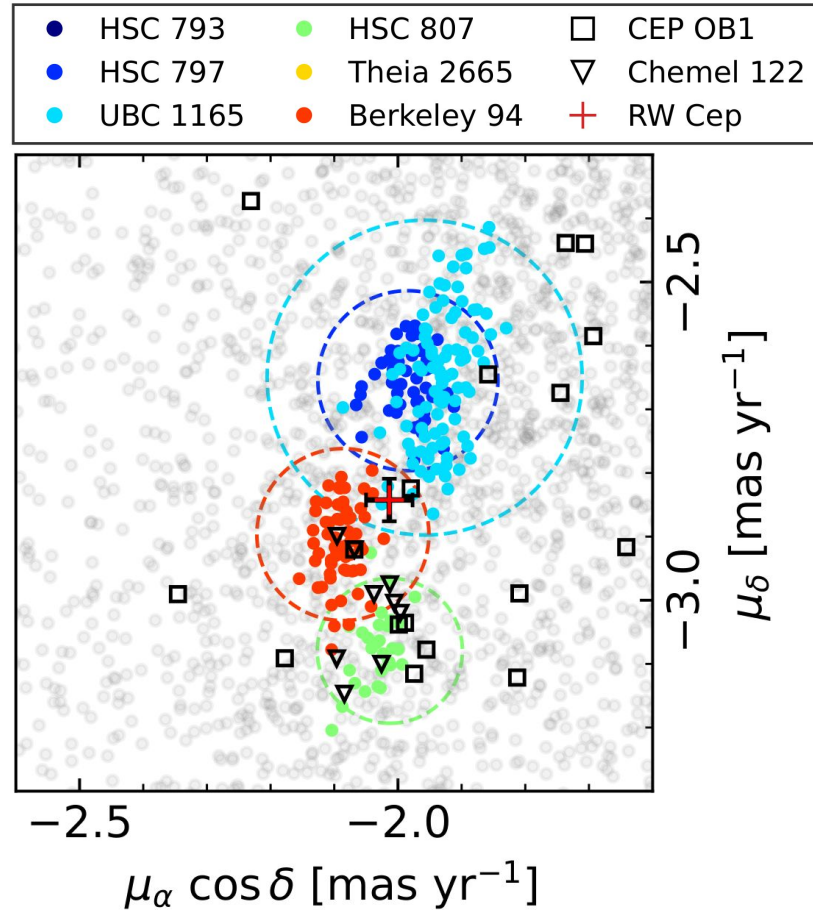
- Large errors in *Gaia* parallaxes
Caused by: photocentre variability, binarity, circumstellar structures
- Distances from indirect methods can differ by thousands of parsecs:
 - Spectral energy distribution modelling
 - Galactic rotation
 - Evolutionary models
 - etc.

Aims:

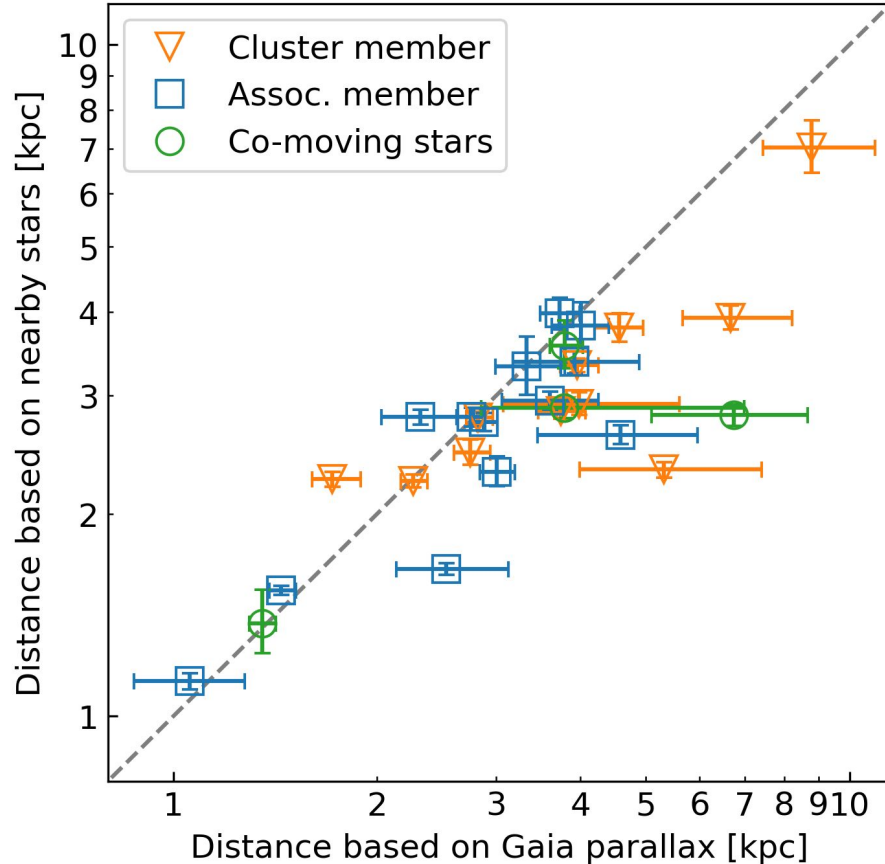
- Provide consistent distances for YSGs and YHG in the Milky Way
- Validate reliability by using two different and independent methods
 - Identification of stellar groups in Gaia DR3
 - Comparison with Galactic H I gas kinematics
- Explore stellar environments of YSGs and YHG:
 - Clusters
 - OB associations
 - Isolated

1. Group-based approach

- Based on Gaia DR3 proper motions
- Cluster or OB association membership
 - Clusters: Hunt & Reffert (2024)
 - OB assoc.: Mel'nik & Dambis (2017) and Chemel et al. (2022)
- Identify co-moving population of hot ($T_{\text{eff}} > 8700$ K) and young (age ~ 10 Myr) stars

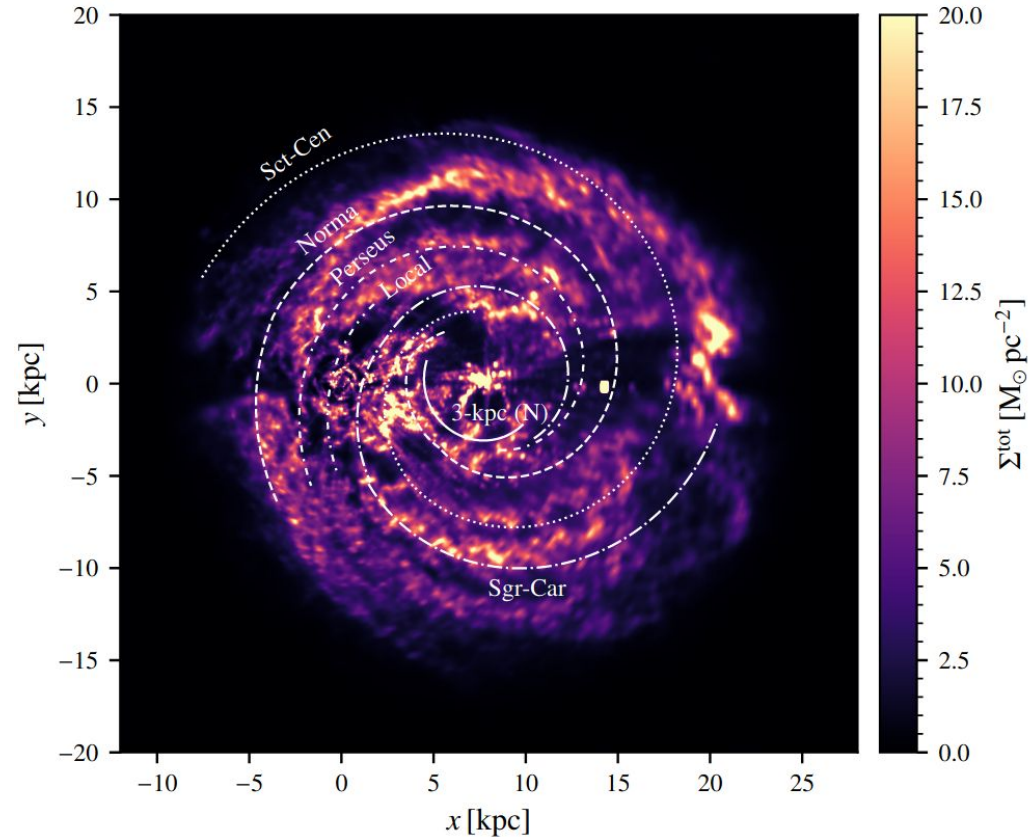


Comparison with *Gaia* DR3 distances

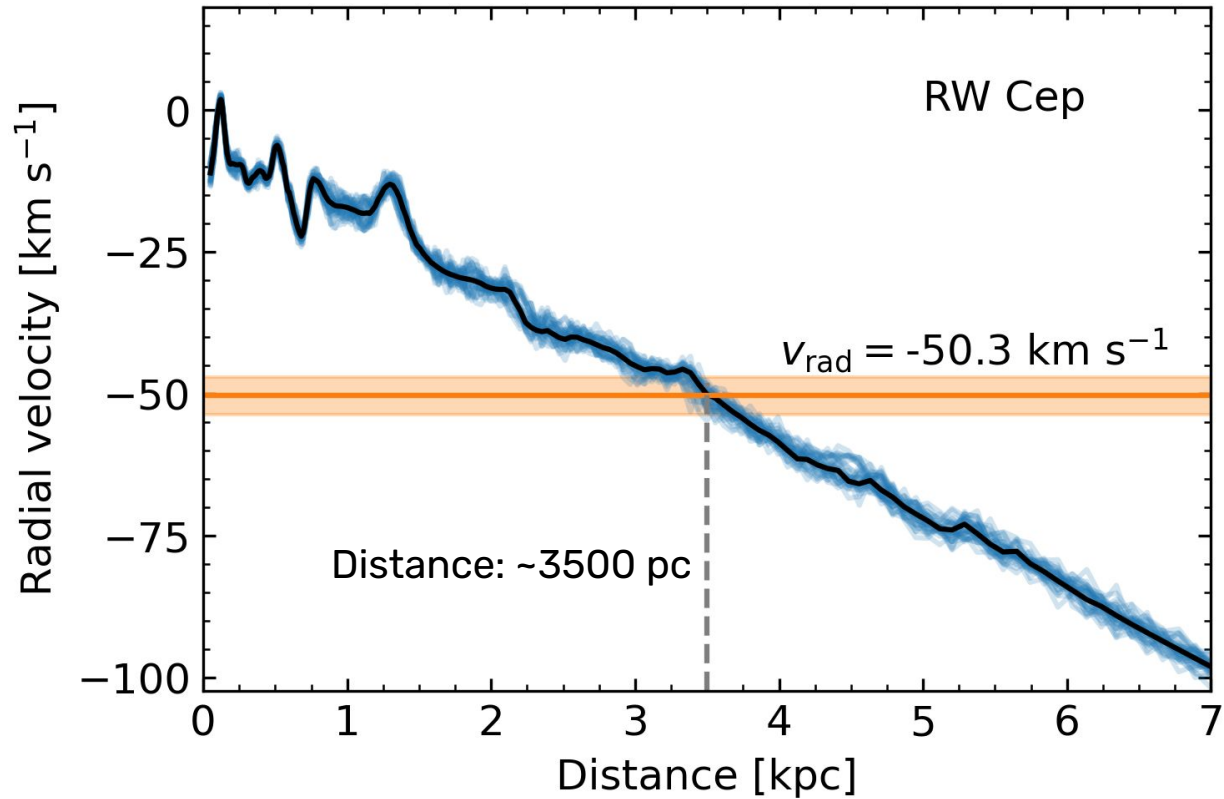


2. H I map-based distances

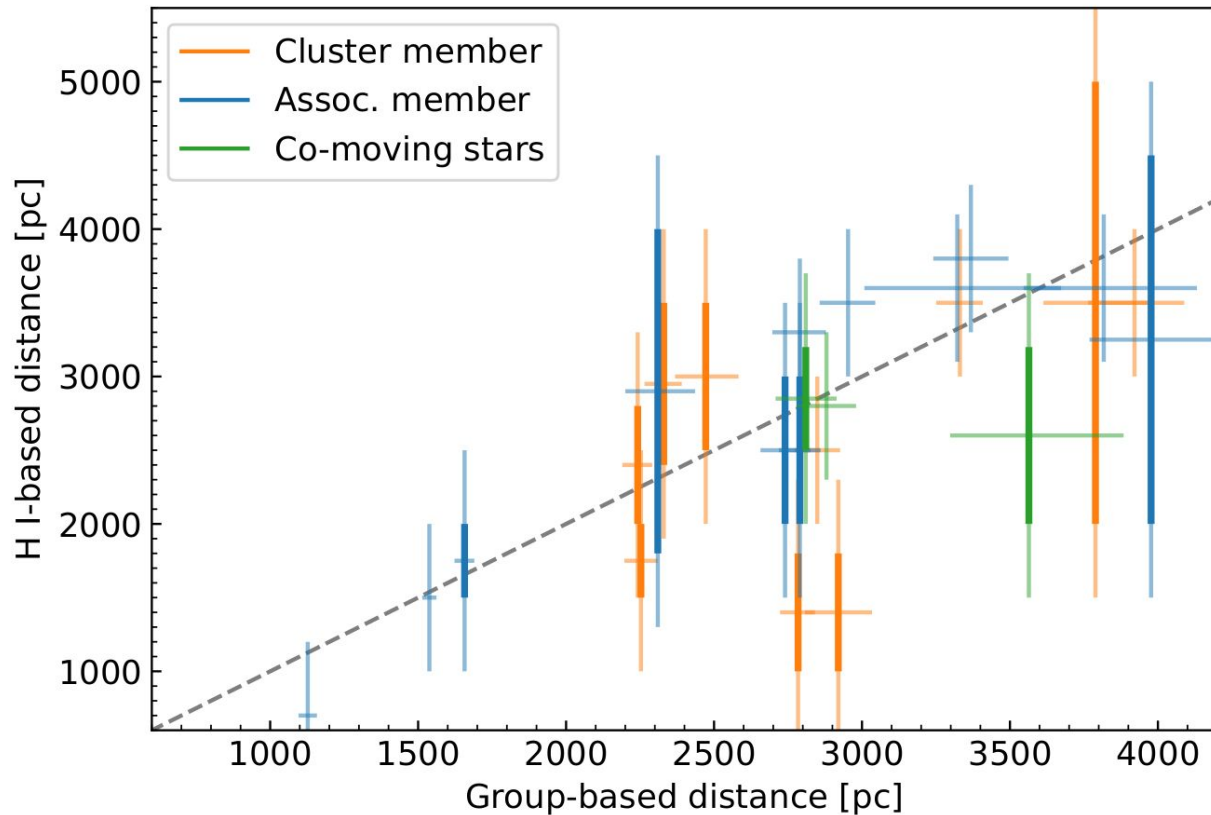
- Traces galactic kinematics on small and large scales
- Similar kinematics to clusters and OB associations
- 3D distribution of H I gas Söding et al. (2025)



Method



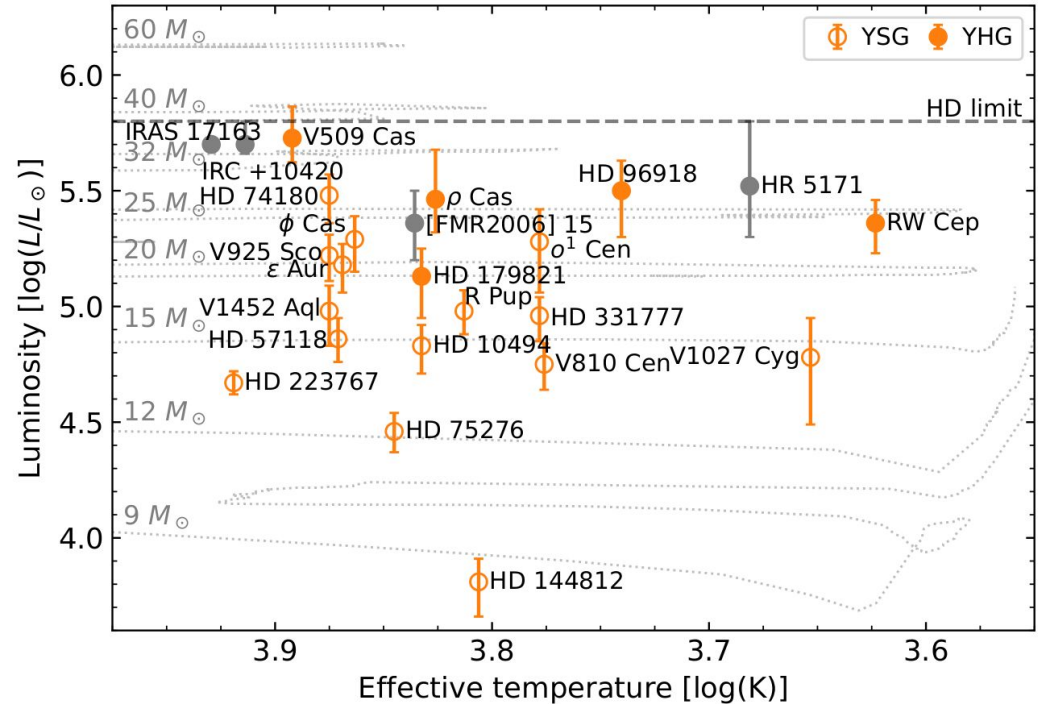
Comparison with group-based distances

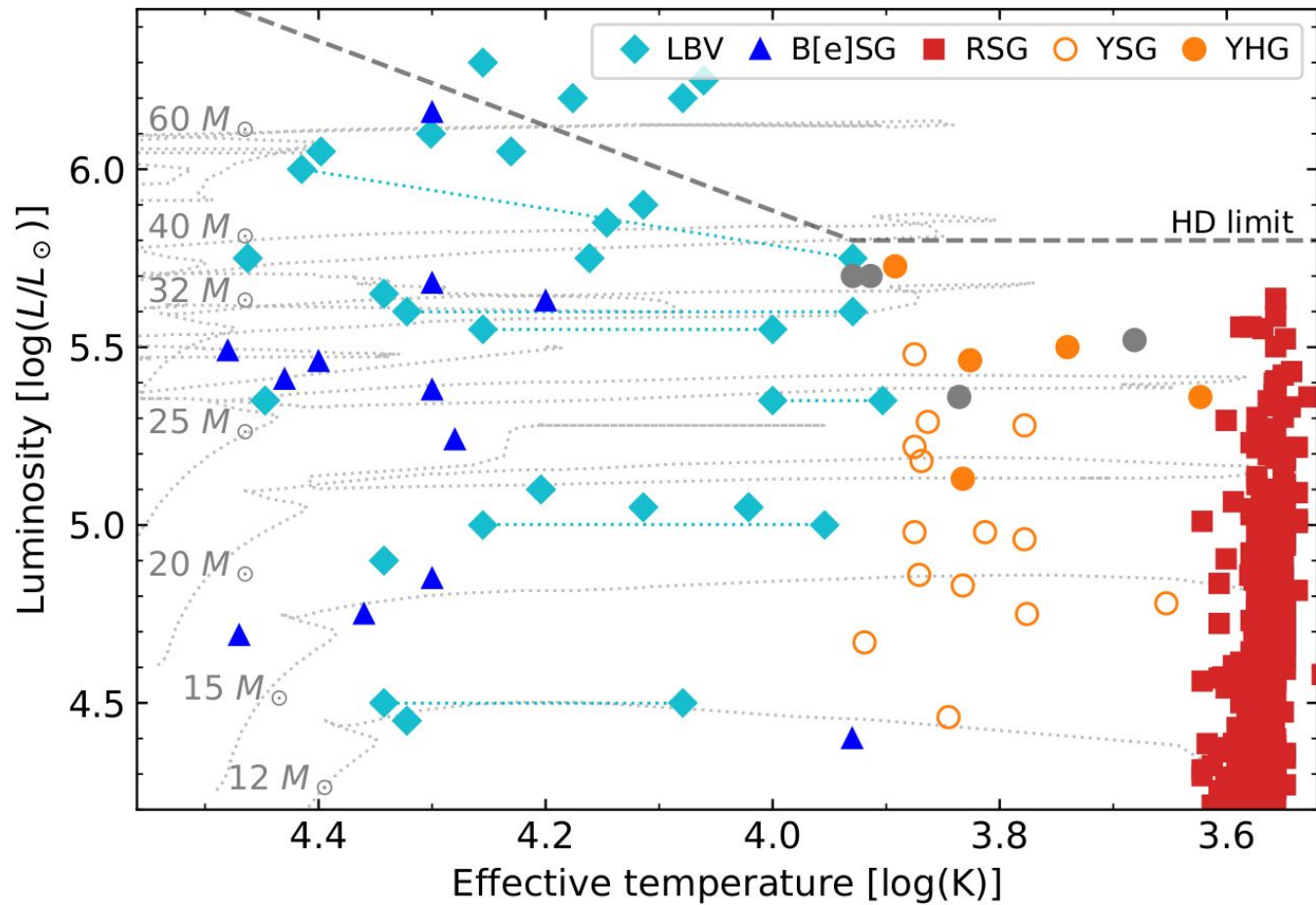


Luminosities

- Angular diameters:
JDSC Bourges et al. (2017)
 - Based on photometric indices
 - Homogeneous data for 20 sample stars
- Effective temperatures
 - Spectroscopic estimates from literature
- Stefan-Boltzmann law:

$$L = 4\pi R^2 \sigma T^4$$





Conclusions

- Consistent distances for 28 YSGs/YHG's using two methods
 - + H I map-based distance estimates for 6 stars
- Luminosity estimates for 15 YSGs and 5 YHG's

Conclusions

- Consistent distances for 28 YSGs/YHG's using two methods
 - + H I map-based distance estimates for 6 stars
- Luminosity estimates for 15 YSGs and 5 YHG's

Yellow Supergiants are in:

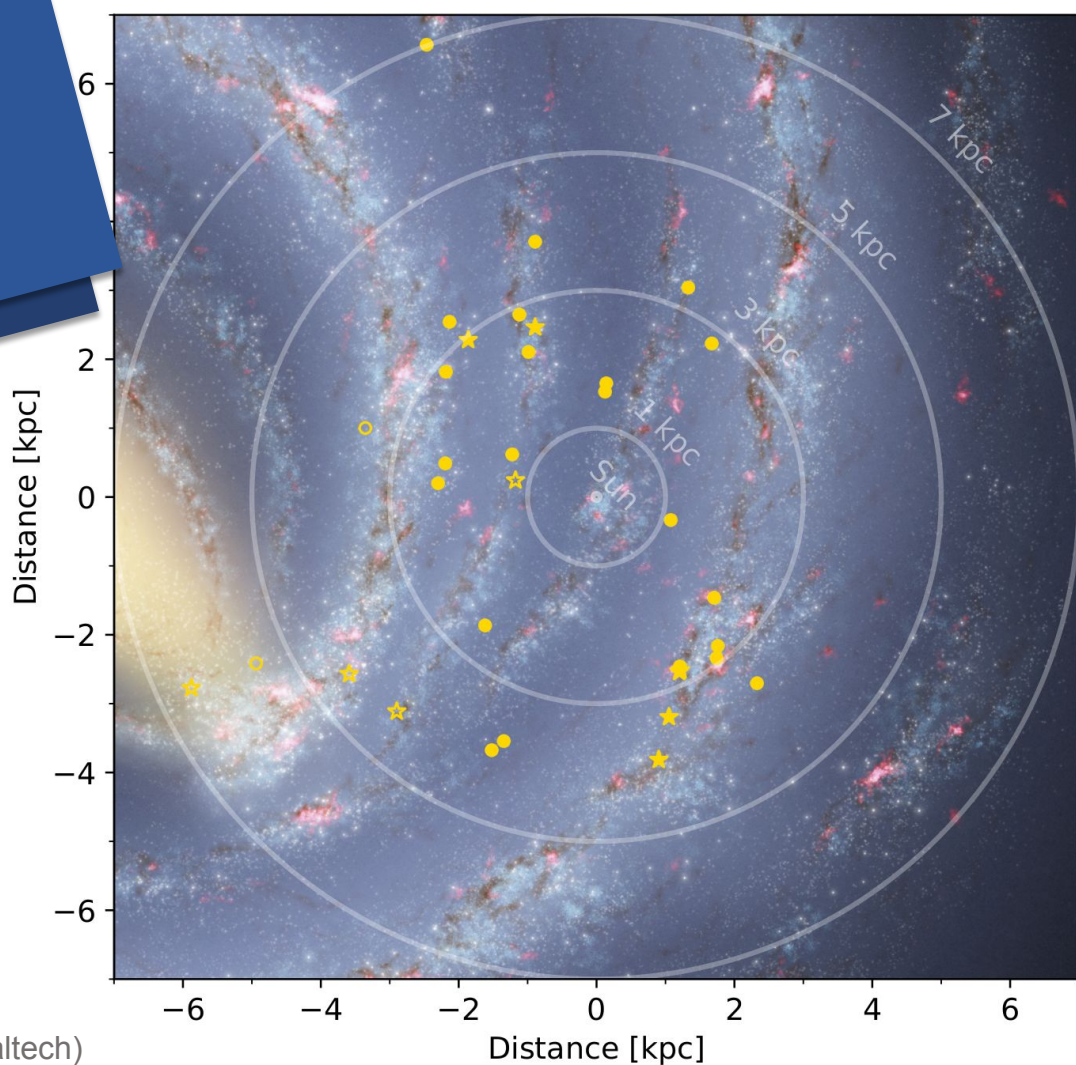
20
grouped { 10 clusters
10 OB associations
3 unaffiliated
2 unknown

Yellow Hypergiants are in:

6
grouped { 2 clusters
3 OB associations
1 star-forming region
2 unaffiliated
2 unknown

Kiitos!

Kasikov et al. (2026)
A&A 708, A78



Milky Way image: NASA/JPL-Caltech/R. Hurt (SSC/Caltech)

References

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Bailer-Jones et al. (2021) AJ 161, 147

Hunt & Reffert (2024) A&A 686, A42

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Mel'nik & Dambis (2017) MNRAS 472, pp 3887-3904

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Bourges et al. (2017) Vizier Online Data Catalogue II/346